Taming the Des Moines Rapids

The Background of Lock 19

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TAMING THE DES MOINES RAPIDS
The Background of Lock 19

by

Roald Tweet

ROCK ISLAND DISTRICT

U.S. ARMY CORPS OF ENGINEERS

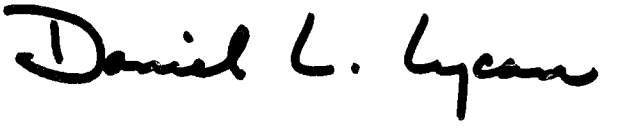
JUNE 1978

FOREWORD

The Rock Island District of the US Army Corps of Engineers is proud of the fact that its long and distinguished history began at Keokuk, Iowa. Lieutenant Colonel James H. Wilson arrived at Keokuk in August 1866 to begin construction of the Des Moines Rapids Canal, which was the first major Corps of Engineers construction project on the Upper Mississippi River.

This was the beginning of continuous improvement work on the section of the Mississippi River at Keokuk, which is the subject of this booklet.

We are indebted to Dr. Roald Tweet, chairman of the English Department of Augustana College and the author of the History of the Rock Island District, for this excellent account of the work of the Rock Island District at Keokuk.



DANIEL L. LYCAN
Colonel, Corps of Engineers
District Engineer

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Fig. 1. Robert E. Lee Map of Des Moines Rapids.

Following the Louisiana Purchase in 1803, the Mississippi River rapidly became an important and well-traveled trade route. By keelboat, raft, flatboat, barge, and canoe, soldiers and settlers, missionaries and mountain men moved up the Mississippi into this rich new territory. Downriver they sent furs, logs, ores, and farm produce. The inland waterways were the only roads.

The steamboat arrived on the Mississippi in 1811. Within ten years passenger and packet boats plied a thriving trade between St. Louis and New Orleans. On the Upper Mississippi, however, north of St. Louis, the new steamboat confronted problems. Here the river was shallow and full of shifting sandbars, with less than a four-foot channel in many places. During much of the summer and fall, low water made the river impassable to all but small boats.

No steamboat came as far north as Keokuk, Iowa, until 1820, when Major Stephen H. Long arrived while on an exploratory trip for the Army Engineers in his strange sternwheel boat, the *Western Engineer.* At Keokuk, Major Long encountered the first of two major obstacles to steam navigation on the Upper Mississippi, the Des Moines Rapids. These rapids, extending from Keokuk at the mouth of the Des Moines River 11¼ miles up the Mississippi to Montrose, afforded a low water channel of no more than twenty-four inches, a severe obstacle even for the shallow draft steamboats of the day.

The Des Moines Rapids had limited traffic on the Mississippi River as far back as the French fur trade of the 18th century. Sac and Fox Indian villages had sprung up at Keokuk and Montrose in response to the need of the fur traders to have their boats unloaded and the cargo carried across the rapids in smaller craft. These "lighters" (as the small boats were called), served Lieutenant Zebulon Pike in 1805 during his expedition to find the source of the Mississippi.

Rivermen all assumed in 1820 that no steamboat would ever conquer the Des Moines Rapids. Together with the Rock Island Rapids to the north, they seemed to make commercial navigation on the Upper Mississippi impossible. Although a small steamboat, the *Virginia,* did cross the rapids twice in 1823 on two trips to Fort Snelling in Minnesota, few others followed.

In 1824 Congress responded to the Country's growing need for transportation by passing the General Survey Act, which gave the President authority to employ officers of the Corps of Engineers to make surveys of navigation routes.

The first such survey on the Upper Mississippi came in 1829, when the chief of Engineers, General Gratiot, ordered Lieutenant Napoleon Buford to "make reconnaisance and survey of the Des Moines and Rock River rapids, with a view to overcoming the obstacles to the navigation of the river at those points." With the assistance of soldiers from Fort Armstrong at Rock Island, Lieutenant Buford surveyed and mapped the two rapids. His maps, though general, were quite accurate, considering that he made his surveys in February, with a foot of ice and nine inches of snow covering the river. In his report, Lieutenant Buford recommended improving the Des Moines Rapids by excavating the existing channel to a depth of five feet.

No further work was done on the Des Moines Rapids until 1837. In that year a young West Point graduate assigned to the Office of the Chief of Engineers requested transfer to St. Louis. Lieutenant Robert E. Lee found official Washington dull and wanted an assignment which would use his engineer training. General Gratiot assigned Lieutenant Lee and an assistant, Second Lieutenant Montgomery Meigs, to St. Louis, with an appropriation of $40,000 for improvement of the Mississippi above the mouth of the Ohio and Missouri Rivers. Lieutenant Lee was directed to resurvey both the Des Moines and the Rock Island Rapids, to determine a plan for improvement, and to begin such work as funds would allow.

Lieutenants Lee and Meigs arrived in St. Louis in August of 1837 and immediately proceeded upriver to survey the rapids. At Keokuk they encountered the Des Moines Rapids first hand when their steamboat ran firmly aground. They were forced to examine the rest of the rapids on foot and by small boat. They then moved to Rock Island where they set up an office on the second deck of a steamboat that had been wrecked and abandoned out in the Rock Island Rapids. When they returned to Keokuk a month later, high water had freed their boat, and they went back to St. Louis.

Lieutenant Lee's maps and surveys were more detailed than Lieutenant Buford's, but he equally underestimated the difficulty of improving the Des Moines Rapids. He agreed with Lieutenant Buford that the natural channel should be excavated to a width of 200 feet and a depth of 5 feet, a project he estimated would require $189,622. Lieutenant Lee's estimate turned out to be short by almost five million dollars.

During the following two seasons, in 1838 and 1839, Leiutenants Lee and Meigs returned to the Des Moines Rapids to supervise modest improvement work, most of it by underwater blasting of rock. Limited appropriations, high water, and unseasonable weather prevented much progress. One Keokuk resident estimated that at Lieutenant Lee's rate of work, the planned cut through the rapids would take 68 years to complete. In 1840 Congress failed to appropriate money, and the work ended.

Between 1840 and 1866 there were only minor attempts to improve the Des Moines Rapids. Lieutenant G. K. Warren made a third survey of the rapids in 1853-54, and experimented with newly developed cutters and steam chisels. Congress did appropriate money to continue this work, but the Civil War intervened before the money could be used.

By 1866, the Corps of Engineers had spent a total of $335,000 on the Des Moines Rapids, but only about 25,000 cubic yards of rock had been removed, with little effect on the channel. Most of the money had been spent on preparations and plans for improvement, and on experiments with new techniques. During low water, steamboats still had to transfer their cargo to shallow draft lighters or to the new railroad between Keokuk and Montrose. During the 1867 season, the Northern Packet Company alone paid $200,000 in lighterage fees.

To understand this lack of progress in spite of the efforts involved, one must understand the peculiar nature of the Des Moines Rapids. Most river rapids were formed like those at Rock Island, with fingers of rock stretching out from both shores, creating a channel which was generally deep enough, but which was dangerous because it was narrow and hidden from view as it twisted from shore to shore and because it created dangerous cross-currents which constantly threatened to push boats out of the narrow channel.

In contrast to the chains and pools of the Rock Island Rapids, the prevailing feature of the Des Moines Rapids was the extreme flatness of the riverbed. The Mississippi River between Keokuk and Montrose flows between limestone bluffs three-fourths of a mile apart, with little bottom land beneath the bluffs on either side. The bed of the river here consisted of almost horizontal limestone ledges, so nearly following the slope of the river that low water made the whole 11¼ miles of rapids impassable. Although in places holes had been worn in these ledges, making it possible for boats to pass the rapids in moderate water stages, there was no channel as such.

To improve these rapids in the way suggested by Lieutenants Buford, Lee, and Warren would have required an eleven mile cut, two hundred feet wide, through solid rock. Even then, the resulting channel would have formed a narrow sluice with an extremely swift current, making navigation dangerous and difficult.

At the same time, the need for improving the rapids was growing. By the end of the Civil War, the five states bordering the Mississippi north of

the Des Moines Rapids were growing more than a third of the produce in the United States. Three hundred and four steamboats were engaged in Upper Mississippi commerce. Most important, the young lumber industry was coming into its own. More than 400,000,000 board feet of lumber was being rafted downriver to saw mills each year. The Des Moines Rapids alone added 2% to the price of this lumber.

The beginnings of permanent improvement on the Upper Mississippi can be traced to the River and Harbor Act of June 23, 1866. Eager to heal the wounds of war and aware of the need to open and improve trade routes between North and South, Congress authorized the Corps of Engineers to create a four-foot channel on the Mississippi north of St. Louis. For this improvement Congress appropriated $200,000 for the Des Moines Rapids, $100,000 for the Rock Island Rapids, and $100,000 for remaining channel work.

The Chief of Engineers, General A. A. Humphreys, ordered Lieutenant Colonel James H. Wilson to Keokuk, Iowa, to superintend the improvement of the Des Moines and Rock Island Rapids and to carry out other survey work. Colonel Wilson's arrival in Keokuk in August of 1866 marked the beginning of a permanent Engineer office on the Upper Mississippi, the office that was to become the Rock Island District.

After a survey of the Des Moines Rapids involving more than 40,000 soundings, Colonel Wilson investigated several methods of improvement. He rejected earlier recommendations for excavating the natural channel because of the expense involved in cutting an eleven mile channel through rock, and the difficulty of marking such a channel, especially at night or in fog. He rejected a dam and lock because they would be a hindrance to navigation during high water.

Based on cost, the needs of navigation, and the nature of the Des Moines Rapids, Colonel Wilson decided on a lateral canal along the Iowa shore as the best solution. A canal with locks would leave the natural channel free both during and after construction, and its slack water would be easy to navigate, especially for boats coming upriver.

The idea of a lateral canal at Keokuk was not new. Captain Henry Shreve, inventor of the snag boat, had suggested such a canal in 1836 following a visit to the rapids. Keokuk residents, too, had long favored the canal plan. A prominent Keokuk citizen, General Samuel R. Curtis, had drawn up detailed canal plans in 1848 for a private group. The plans called for the canal to be constructed by building an embankment out in the river and excavating the space between the embankment and the shore. General Curtis' plans were also different from Shreve's in that they called for a single lock with a 24-foot lift, while Shreve's plans did not use locks at all.

Although the design drawn up by Colonel Wilson and his staff called for three locks rather than one, and differed in dimensions, it was remarkably close to the design of General Curtis. Colonel Wilson's plan called for a canal 7.6 miles long from Keokuk upriver to Nashville. From here to the head of the rapids, the natural channel would be excavated as needed, primarily at a 2,400-foot stretch known as Upper Chain. The canal would provide a channel 300 feet wide and 6 feet deep. This was two feet deeper than called for in the Act of June 23, 1866, but Colonel Wilson correctly foresaw that increasing river traffic would soon require a deeper channel.

Congress was suspicious of the canal plan, but a Board of Engineers convened by General Humphreys supported Colonel Wilson. They did, however, reduce the depth of the canal to five feet.

On October 18, 1867, Colonel Wilson and the contractor located the centerline of the canal and moved the first wagon load of earth for the embankment. The embankment was built first as a buffer for the rest of the construction. Problems with appropriations, contractors, and nature delayed construction, but by 1870 the work force was up to 1,000 men. Two small locomotives with sixty-six cars built especially for the project ran from stone quarries near Keokuk to the canal site on tracks which were extended up the embankment as it was built.

When the Des Moines Rapids Canal finally opened to traffic in 1877, it had cost $4,155,000. On the morning of August 22, 1877, the Rock Island District snagboat *Montana* with District Engineer Colonel John N. Macomb on board entered the guard lock at the head of the canal to the accompaniment of flags, bands, and cheering spectators.

The finished embankment of the canal contained 884,325 cubic yards of earth and 97,000 cubic yards of rock excavated from the canal prism and from the channel above the canal. The embankment varied from sixty to ninety feet at the base and rose from sixteen to twenty-seven feet.

Within the canal prism were a guard lock and two lift locks, which provided a total lift of 18.75 feet. The lower lock was at Keokuk; the middle lock was 2.5 miles above the lower; and the guard lock was 5.1 miles above the middle lock.

The locks were constructed of magnesian limestone from the Sonora Stone Quarries on the bluff adjacent to the river. Each lock had miter gates of cedar and cypress wood. These gates were so sturdy that workmen had trouble taking them apart when they were removed for repairs twenty-five years later.

Each lock was 350 feet long, 80 feet wide at the surface, and provided a minimum depth of five feet. The usable lock space, considering clearance for the gates, was 291 feet by 78 feet, although boats larger

than 291 feet could be squeezed into the lock by opening one gate at a time and angling the boat.

At each lock was a 27-square-foot stone building housing lock operating machinery. Gates were opened and closed by a steam pump, so that only one man was needed to operate each lock. As with all future locks in the Rock Island District, filling and emptying was by gravity.

As the Des Moines Rapids Canal neared completion, a new employee joined the Rock Island District. He was Montgomery Meigs, a United States Civil Engineer and son of Lieutenant Robert E. Lee's assistant during the earlier rapids improvement project of 1837-40. Montgomery Meigs became extremely knowledgeable of District operations and served a number of District Engineers as innovator and advisor. In 1884 he was placed in charge of the Des Moines Rapids Canal. He remained in charge of the Keokuk office until his retirement in 1926.

One of Montgomery Meigs' first major projects was the Des Moines Rapids Canal Dry Dock which was authorized in 1883 and completed in 1889. The dry dock was located on low Government land on the river side of the canal embankment just above the middle lock. It furnished a basin 400 feet by 100 feet, with an 80-foot entrance from the canal through two 40-foot miter gates. Up to a stage of six feet above low water, the dry dock drained by gravity into the river. Between six and twelve feet above low water, drainage was into the canal. Above that, electrical rotary pumps were used to empty the dry dock.

The dry dock received constant use from both Government and private boats in need of service or repair as it was the only one on the Upper Mississippi. Here, and at the Rock Island District Boatyard at Keokuk, Montgomery Meigs designed and built many of the steamboats and barges for the rapidly expanding Rock Island District fleet.

For many years the Des Moines Rapids Canal performed well, exceeding expectations. During high water a steamboat could make the trip down the rapids in less than forty minutes, compared to the one and one-half to two hours needed to travel the canal, but the dangers of the natural channel, especially at night, outweighed the time advantage and 85% of boats coming down river used the canal. Up river, against the current, boats almost always preferred the canal. Only the massive log rafts floating down river found the canal difficult. They had to be broken up and reassembled below the canal, a procedure that often took forty to fifty hours.

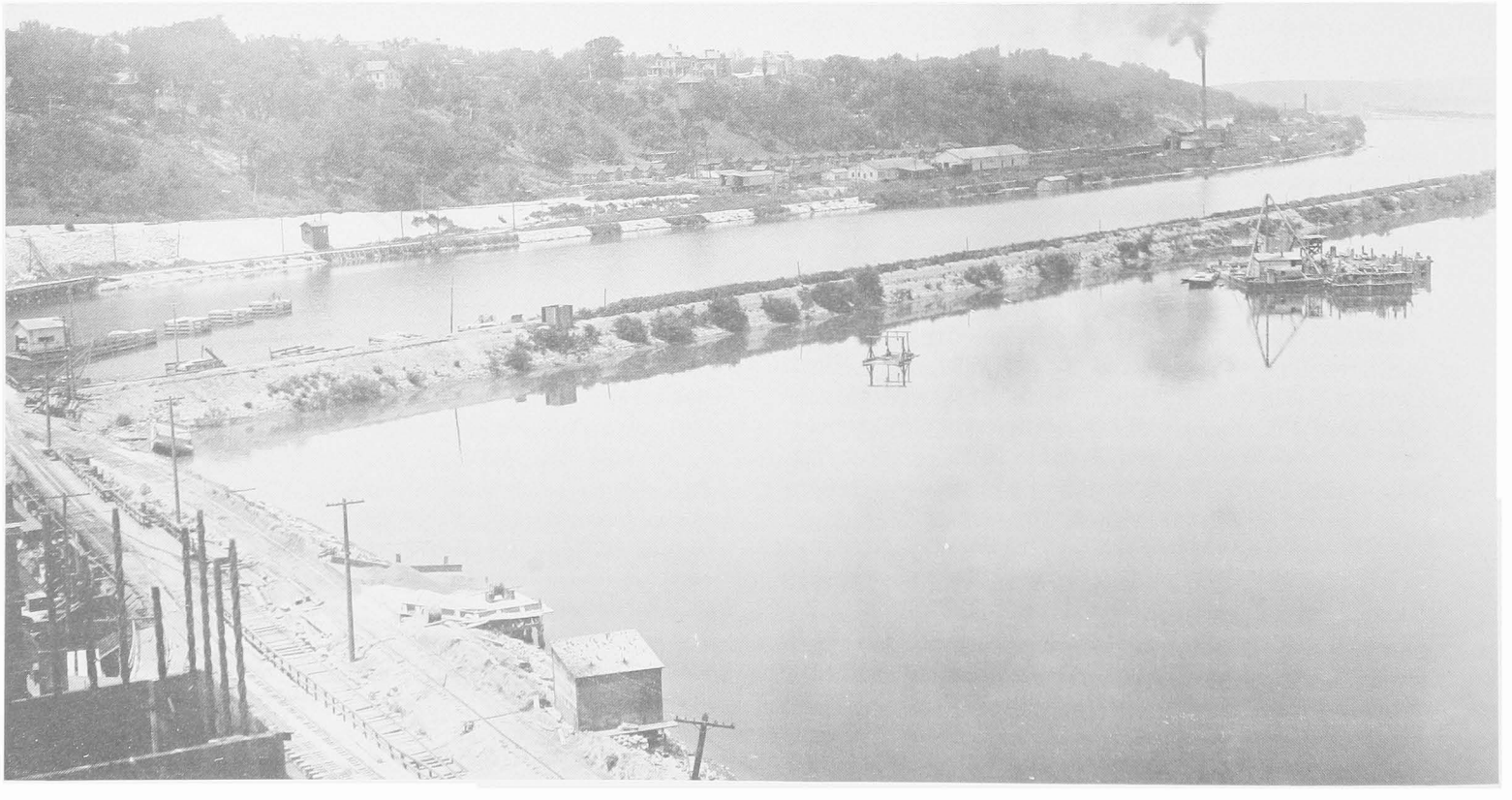


Fig. 2. Guard Lock, Des Moines Rapids Canal.

The beginning of the end for the Des Moines Rapids Canal came shortly after the turn of the century when the Keokuk and Hamilton Water Power Company requested permission of Congress to build a dam across the Mississippi at Keokuk to generate electricity. As a part of its project, the power company propsed to replace the three locks of the canal with a single lock at the dam site, with a lift of 40 feet. This lock would be turned over to the Corps of Engineers after completion.

Such a dam marked a serious shift of direction for navigation improvement on the Mississippi. Several earlier dams had been proposed at various locations, but none had ever been built. Joseph Smith and his Mormon followers at Nauvoo, Illinois, at the head of the rapids, had planned to build such a dam for power and navigation purposes in 1844, but Smith was killed and his followers left for Utah before that dam could be built. Bridges were causing some interference with navigation by 1900, but the entire length of the Mississippi was free of dams.

The River and Harbor Act of June 13, 1902, authorized a survey of the Mississippi at Keokuk "to determine whether a dam constructed at the foot of said rapids would be a benefit or impediment to the navigation of said river." The subsequent detailed and careful examination and report by Montgomery Meigs was favorable to the project. A single lock, together with the deep long pool which the dam would create, would flood the entire Des Moines Rapids, cutting both time and operating expense by 20% over the canal. The raft traffic would suffer from obstructing the natural channel, but that traffic was already dying. In 1902 only one sawmill remained on the Mississippi south of Keokuk.

Meigs held a meeting at the Keokuk Office on April 24, 1903, to receive objections to the proposed lock and dam, but there were none. Local residents and commercial interests favored the plan.

In 1905 Congress authorized the Keokuk and Hamilton Water Power Company to proceed with the design and construction of the project. In addition to a new lock, the company was instructed to build a new dry dock to replace the canal dry dock, and to provide free power to operate all lock and dry dock machinery. The lock was to be of sufficient dimensions to meet the requirements for an improved six-foot channel, preliminary examinations for which were also authorized in 1905.

From the beginning, relations between Government and power company employees were both cordial and helpful. Montgomery Meigs and Hugh Cooper, chief engineer of the project, worked together to avoid obstruction to navigation and to consider all the varied river interests in their planning.

Actual construction began in January 1910. Throughout the project, two complete crews worked, one from the Illinois side building the dam, and the other from the Iowa side building the dry dock, the lock, and the power house. For three years the dam slowly grew across the river, a cofferdam to keep the construction site dry proceeding just ahead of the work.

Construction on the Iowa side was more complicated because it involved a number of projects, and because the canal had to be kept open to navigation. One of the first steps was the construction of a 90-foot temporary drawbridge across the canal just north of the lower lock to permit access to the worksite for workmen, train tracks, and other heavy equipment. This bridge was completed in March, 1911.

At both the Iowa and Illinois sites workers' camps were built, along with warehouses and construction yards. At each site, work crews built a rock crusher plant and a concrete mixer plant designed to put out 1,500 cubic yards of concrete a day. Sand for the concrete was pumped out of the Des Moines River, while quarries for rock and cofferdam material were opened along each shore.

Construction on the Iowa side began in the spring of 1911 with the powerplant. A cofferdam surrounding 23 acres was built out from the Des Moines Rapids Canal embankment. Here work on the powerplant and new lock progressed during 1911 and 1912.

By the middle of 1912 the dam was three-quarters of the way across the Mississippi. At its peak the project employed 1,200 men and used three steam shovels, five derrick cars, thirty dump cars, and fifteen locomotives operating over twenty miles of track.

In order to make way for the final stages of construction, Government employees closed the Des Moines Rapids Canal for good on October 31, 1912. The lower lock and lock grounds were then gradually filled in with waste from the new drydock excavation immediately east of the lower lock. A sea wall was built from this new dry dock across the canal to the Iowa shore. By the time the dry dock was completed in 1914, the lower lock of the Des Moines Rapids Canal lay under nearly fifty feet of fill.

The last concrete was poured in the dam in May of 1913. On May 31, the company, now called the Mississippi River Power Company, held a locomotive parade across the new dam from Illinois to Iowa.

The completed lock was turned over to the Government in late spring. On June 12, 1913, Rock Island District employees opened the lock with little fanfare, eighteen days ahead of schedule. The first boats into the locks came up river: the *Sidney* of

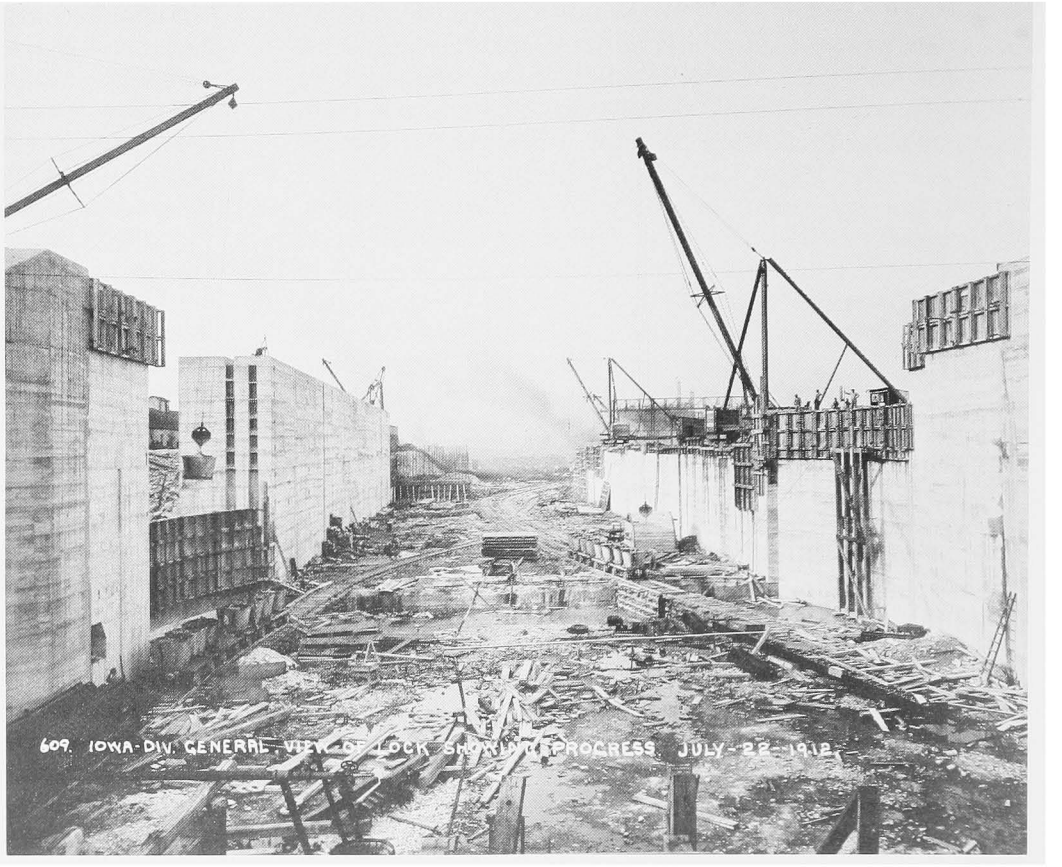


Fig. 3. Construction of Old Keokuk Lock, taken in July 1912.

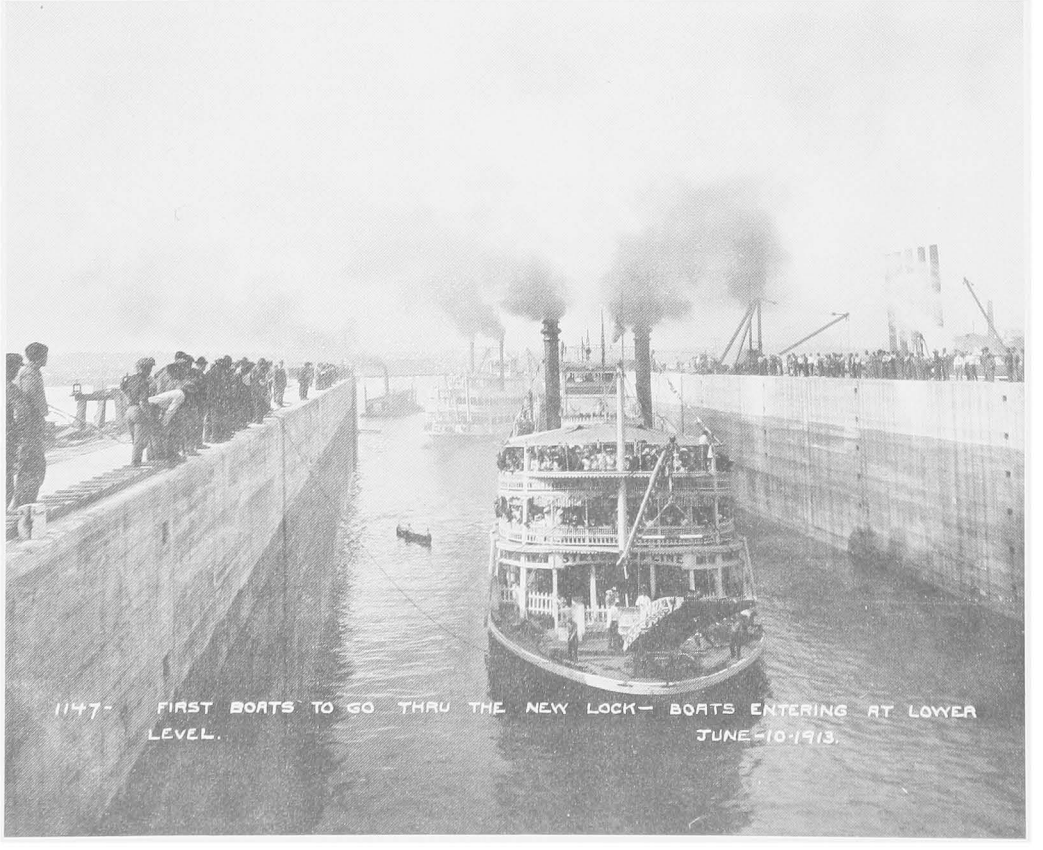


Fig. 4. First Boats through Old Keokuk Lock, taken 10 June 1913.

the Streckfus Line, with Captain Streckfus and 405 passengers on board, and the tow boat *G. W. Hill.* Montgomery Meigs sent a wire to Major Keller, District Engineer at Rock Island:

> The Hill and Sidney first boats through at nine A.M. Five hundred people on boats. Operation of locks perfect, twenty minutes with partial gates. Water at five nineteen eighty. We are breaking the blockade as fast as possible.

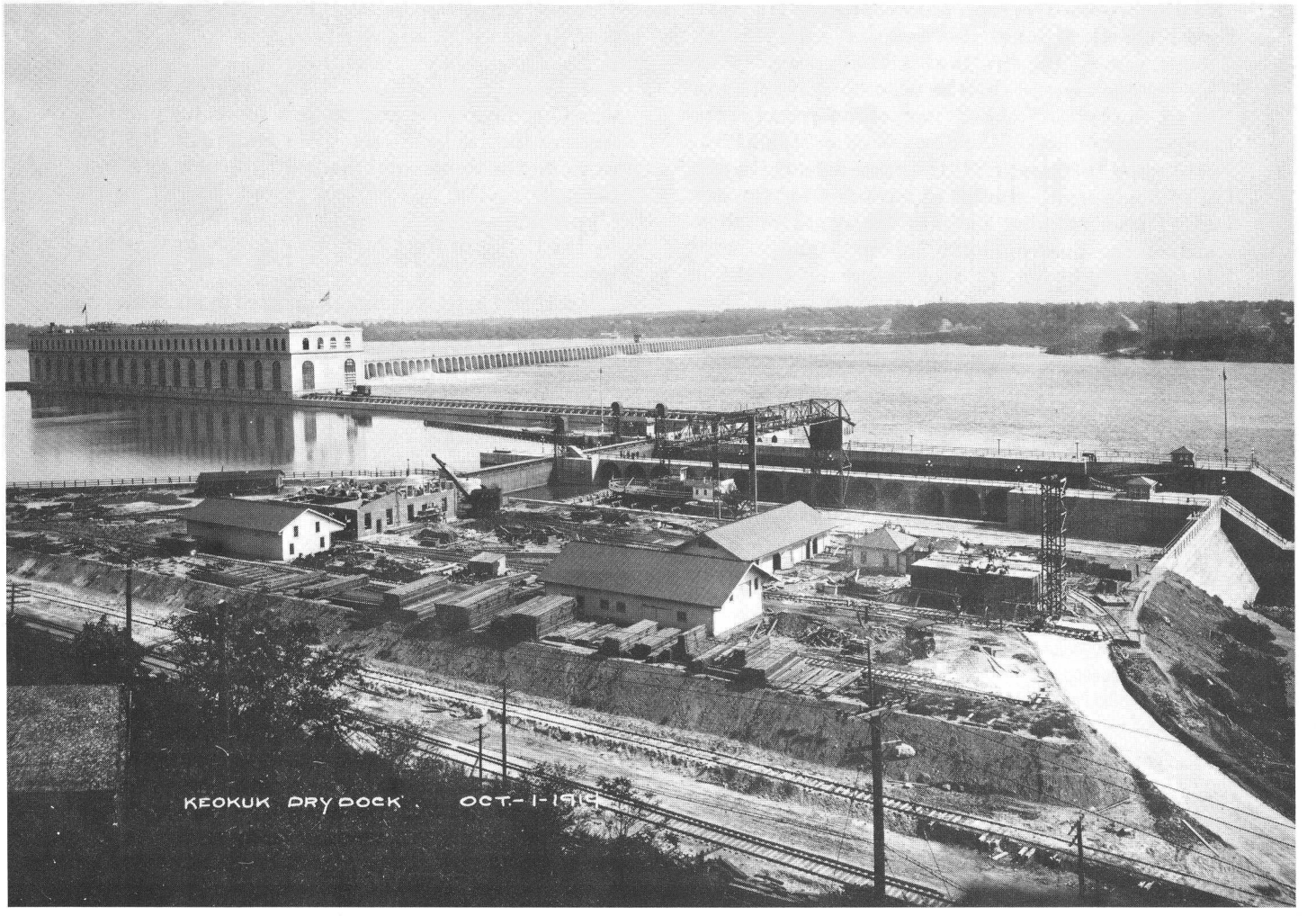
In all ways the new lock was an improvement over the canal locks. The 90-foot width authorized by Congress had expanded to 110 feet, and the 400-foot length provided a minimum depth of seven feet over the lower miter sill at extreme low water, and a lift of forty feet. Traditional miter gates were used at the lower end of the lock, but both lock and dry dock used floating gates that submerged to permit access from upstream. Filling and emptying were by gravity, through culverts in the lock walls and beneath the lock floor. The power company estimated the cost of the lock at $640,000.

The new dry dock was finished in the spring of 1914, complete with a sawmill, lumber shed, ice house, storehouse, and shops.

The Mississippi River Power Company installed lights at the lock grounds and provided free power to run all machinery, giving Meigs and his staff twenty times the light and power that had been available at the old canal.

For the next seventeen years the Keokuk lock and dry dock performed well. The lock was larger in all dimensions than the two other locks in the Rock Island District: the Moline Lock, completed in 1907, and the Le Claire Canal Lock, completed in 1922. Its size was increasingly justified by river traffic, which was rapidly increasing from a period of severe decline in the early 1900's.

Fig. 5. Corps of Engineers Keokuk Boatyard, Drydock and Old Lock 19. Picture taken in October 1914.



By 1927 this commercial traffic had grown to the point where Congress authorized studies for further channel improvement. These studies led Congress, in the Act of July 3, 1930, to authorize a nine-foot channel on the Upper Mississippi, to be achieved by a series of locks and dams between St. Paul and St. Louis. The locks were to be 110 feet by 600 feet, the size that had been adopted as standard on the earlier Ohio River project. Each dam was to have a main lock and either an auxiliary lock, or provisions for one. As part of this project, the existing Keokuk lock would become Lock 19.

The same act which authorized the nine-foot channel also authorized a second lock at Keokuk to meet the standard 110-foot by 600-foot dimensions. The existing lock, which also lacked the nine-foot depth required, would become the auxiliary lock.

Planning for this new lock was begun by the Rock Island District in 1930, but there were problems with its location. Building the new lock east of the existing one would interfere with the power plant, while a new lock on the landward side of the dry dock would isolate the dry dock from land, making the delivery of supplies difficult.

To overcome these problems District engineers first planned to build the new lock immediately downstream of the dry dock and connected to it. The dry dock would then be used only in emergencies or during the closed navigation season. The first estimated cost of the new lock was $1,500,000.

Between 1935 and 1937 the Rock Island District Office made many studies of locations for the new lock. These included building landward or riverward of the existing lock, enlarging the existing lock, extending the dry dock to create a 600-foot lock, and using the site of the dry dock itself. These studies concluded with plans to build the lock at the dry dock and build a new dry dock landward of the lock. The design of this lock was to be consistent with the other locks on the 9-foot channel project, most of which were now nearing completion.

Numerous tests for filling and emptying systems were carried out between 1938 and 1941. In 1941 the Office of the Chief of Engineers authorized the Rock Island District to proceed with detailed plans and specifications for a new lock at the dry dock location and to undertake model studies.

At this stage of design, District engineers planned to use a Tainter gate in lieu of miter gates at the upper end of the lock. Tainter gates used in several of the dams on the nine-foot channel project had given superior performance under the ice conditions on the Upper Mississippi. This Tainter lock gate would submerge to admit boats during locking, rather than opening against the lock walls as the miter gates did.

A dramatic change in planning for new Lock 19 occurred in 1945. Completion of the nine-foot channel project had created a bottleneck at old Lock 19. Lines of tows often waited many hours to pass through the smaller lock at Keokuk. Responding to studies within the District which showed a clear trend toward heavier and longer tows on the Upper Mississippi, Rock Island District planners recommended to the Office of the Chief of Engineers that the length of new Lock 19 be expanded to 1,200 feet. The 38.2-foot drop at Keokuk was by far the largest of any lock in the District, and the capacity to lock through one long tow would be especially time-saving.

With the change of dimension came a change of location. The Rock Island District proposed to build this new lock on the landward side of the dry dock, almost directly over the site of the Des Moines Rapids Canal.

A hearing was held in Keokuk on August 16, 1945, to explain the project to the public and to receive opinions about the lock from navigation interests and others. Several hundred notices were sent out to congressmen, senators, local politicians, corporations and private citizens, but fewer than fifteen people showed up at the meeting chaired by District Engineer Lieutenant Colonel John Peil. Japan had surrendered two days earlier, and the whole country was celebrating.

General opinion toward the project, however, was very favorable, and modest funds for planning were authorized between 1946 and 1949. By 1950 work on the design and plans for the new lock were being carried on by the Rock Island District, by the Upper Mississippi Valley Divison at St. Louis, and by the Office of the Chief of Engineers in Washington, D. C.

In 1950 District planners decided against moving the dry dock to another location in the District. Instead, the dry dock would remain at Keokuk for use on an emergency basis, while a service base for storage and repair would be established near the old Le Claire Canal Lock.

Final model tests of the new 1200-foot lock were performed by the St. Paul District at Government Laboratories in Iowa City, Iowa. At this point, plans still called for a Tainter-type upper service gate. A submersible, vertical lift gate was substituted in 1952 just prior to the start of construction.

With plans and specifications nearly done, Congress, in 1952, appropriated $994,000 to begin construction. While the Korean War brought nearly all other activity in the Rock Island District to a standstill, appropriations for new Lock 19 continued on schedule, an indication of the economic and military importance of the project.

All of the work on New Lock 19 between 1952 and 1957 was contracted out in four stages involving four separate contracts.

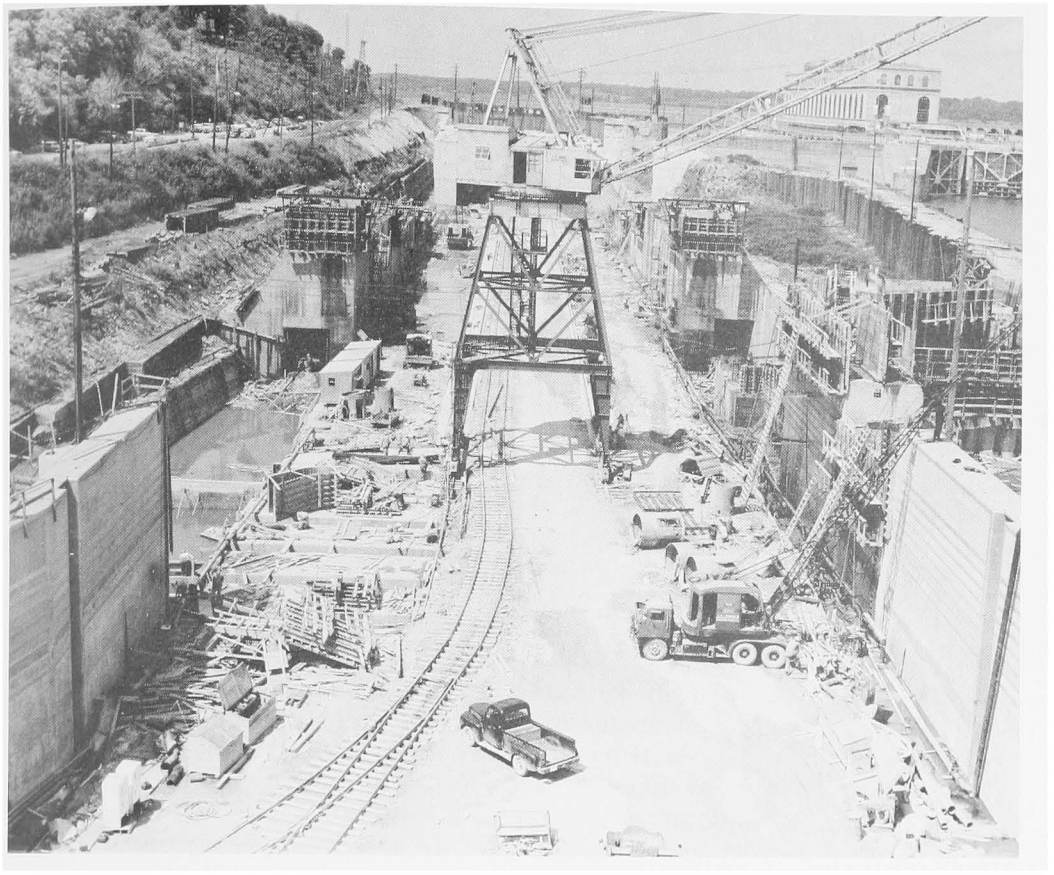


Fig. 6. Construction of New Lock 19, taken in June 1955.

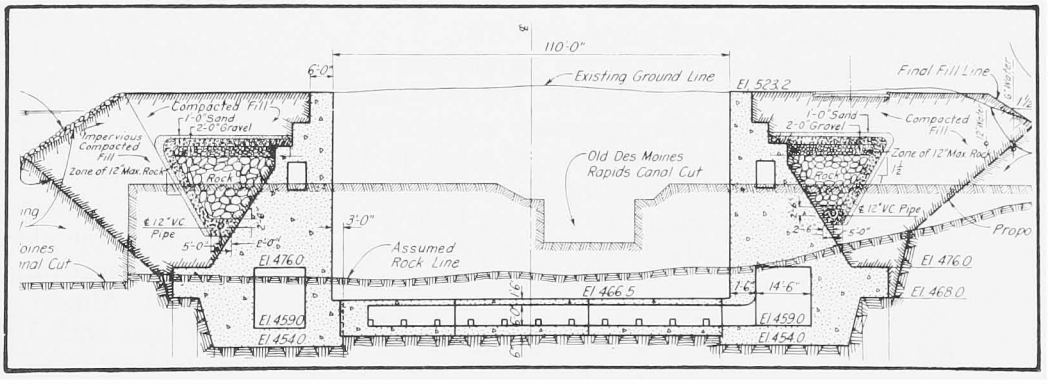


Fig. 7. Cross section of New Lock 19.

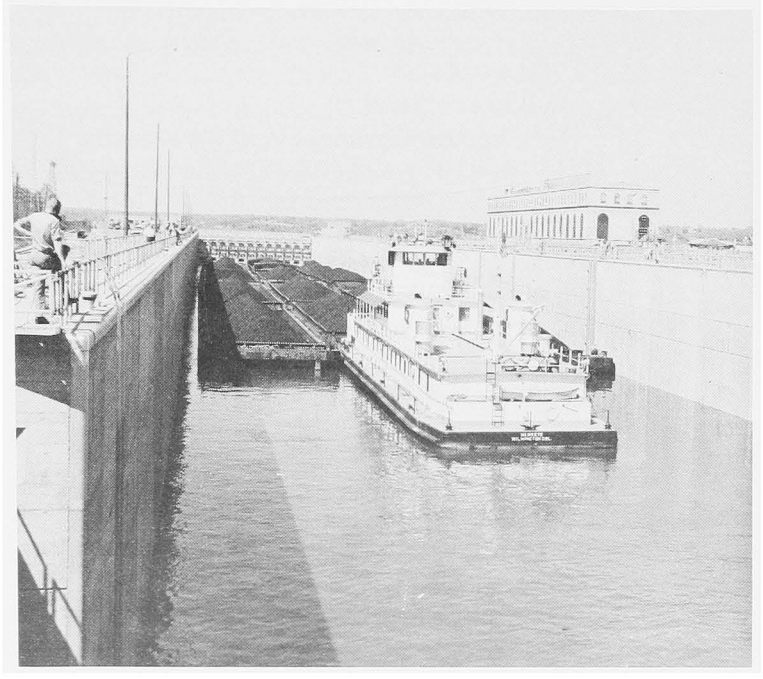


Fig. 8. Towboat "Hawkeye," first towboat and barges through New Lock 19. Picture taken 30 April 1957.

Stage I consisted of the lower guide wall extending from the lock proper. These guide walls were longer than usual so as to insure a proper lineup for tows. The river guide wall extended far enough to enclose the swing pier of the Keokuk and Hamilton Bridge downstream from the lock, making passage through the bridge easier and safer. Stage I was begun late in 1952 and completed in April of 1954.

A month later construction began on Stage II, consisting of the lock proper, the lock gates, Tainter valves for filling and emptying, operating machinery, and the esplanade around the lock. Stage II was complete enough to operate by the spring of 1957.

Stages III and IV were smaller contracts, involving mechanical and electrical equipment for operating the lock, and the installation of this equipment. These stages, too, were complete in 1957.

With new Lock 19 nearing completion in the spring of 1957, Rock Island District officials planned a ribbon-cutting ceremony to celebrate the opening, scheduled for the second week in May. However, on May 1, while the Stage II contractor was testing the operation of the new lock prior to turning it over to the Corps of Engineers, a tow coming upstream, waiting to go through old Lock 19, encountered cross currents caused by the testing and requested permission to go through the new lock. The contractor received permission from the Rock Island District to do so, and so the *Hawkeye* with twelve barges of coal became the first boat through the lock. This first locking through took one hour; at old Lock 19 the same tow would have required five hours.

Two weeks later, on Tuesday, May 14, the Rock Island District formally opened new Lock 19. When the lock opened at 8 a.m., the *Lachlan Macleay* of the Federal Barge Lines entered the lock, greeted by only a handful of District employees. The tow of seven barges of steel, sulphur, and coal locked through in one-half hour.

Formal dedication ceremonies for new Lock 19 were held on August 19, 1957. In addition to Rock Island District personnel, speakers at the dedication included Assistant Secretary of the Army Dewey Short, Chief of Engineers Major General Emerson C. Itschner, and Iowa Governor Herschel Loveless. The official dedication at 3:00 p.m. followed a luncheon, open house, and parade.

New Lock 19 was completed at a cost of 13.5 million dollars, some what more than the original estimate of 1.5 million. It still remains the largest and most impressive lock on the Upper Mississippi. Lock 19 furnishes a useable lock chamber 110 feet wide by 1,200 feet long. Depth over the upper sill is fifteen feet, with thirteen feet over the lower sill. The maximum lift at low water stages is 38.2 feet.

All three lock gates are of steel construction. The downstream gate is a miter type, while both the upper service gate and the guard gate are submersible, vertical lift gates. In addition to protecting the service gate against damage from tows and ice flows, the guard gate serves as a roadway for vehicle access to the old lock and power dam.

As with all other locks in the Rock Island District, Lock 19 is filled and emptied by gravity. Intake and discharge valves control the water, which enters through intakes in the upper sill and is distributed to the lock through lockwall culverts. These, in turn, distribute the water to lateral culverts under the lock floor. The same system is used to discharge the water at the downstream end of the lock. The filling and emptying system fills the lock chamber in approximately 10 minutes and empties it in approximately 9 minutes. Just over 38,000,000 gallons of water are used for each emptying or filling.

Today, Lock 19 is the pride of the Rock Island District. Although the old lock and dry dock have now been sealed off by a permanent upstream cofferdam because of their deteriorating condition, visitors to Keokuk still have an unusual chance to compare the old and the new, side by side, and to see dramatic proof of the health and growth of river traffic. Almost 23,000,000 tons of cargo passed through Lock 19 in 1977. The Des Moines Rapids have been tamed in a way that no riverman in 1820 could even have imagined.

BUILDING
TOMORROW
TODAY